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DEVELOPMENT OF THE SMALLER INDUSTRIES IN FIJI.

Owing to the fall in price of our staple products in the world's markets efforts have been made to find markets for our local products with the object of developing the smaller industries in Fiji, and, if possible, starting entirely new ones. With these objects in view inquiries were made from an authoritative source in New Zealand as to the demand for some of our local products there and the prices which would be offered for them. The notes based on this information are printed below, and it will be seen from them that there is quite a promising market in New Zealand for peanuts and coffee. Additional notes have been added by the Acting Superintendent of Agriculture, from whom further information on any of the subjects dealt with can be obtained.

NOTES BASED ON INFORMATION OBTAINED FROM AN AUTHORITATIVE SOURCE IN NEW ZEALAND.

Leaf tobacco.—It appears that Fijian and New Zealand tobaccos cannot be compared with Virginian, South African or Australian tobaccos, and the opinion has been expressed that the nature of the soil and the climatic conditions are not such as to render possible the production of tobacco in Fiji which could command a price in the world's markets or be saleable in New Zealand.

Maize.—The requirements of New Zealand are normally met from local production, there being approximately 11,514 acres under grain cultivation. During the last few years, however, a certain amount of maize has been imported from South Africa and Java, but there is said to be sufficient maize grown within the Dominion at the present time to meet the demand, particularly as poultry farmers are using wheat to a larger extent than previously in preference to maize on account of the lower prices now ruling for wheat.

The prices quoted on the 28th June, 1922, for Dominion maize were:—Gisborne, 4s. 9d. per bushel of 56 lb; Wellington, 5s. 9d. per bushel of 56 lb.

A factor that has been considered by firms wishing to export maize to this Dominion is that all importations are subjected to Government analysis and unless the maize is passed as " clean, fine and whole " it is fumigated, which often means a considerable outlay to the importer on account of transport ex steamer to fumigating station, warehouse, &c., so that unless prospective importers are assured of the maize being of the finest possible quality as required by the Government they would not consider it worth while placing orders. One of the leading firms of general merchants in New Zealand has expressed the opinion that a demand for Fijian maize would certainly be created provided that prices and quality are able to compare with the New Zealand grain. In this connection the firm state that they would be very glad to receive samples and prices of Fijian maize and have expressed a wish to be placed in touch with firms in Fiji in a position to export to this Dominion. The name of the firm is:—Messrs. Wright Stevenson & Co. Ltd., Customhouse Quay, Wellington.

Coffee.—The principal sources of supply are Java, Straits Settlements, Southern India and Ceylon. There is a fair demand in the Dominion and provided the Fijian product is able to compete in quality and price with the coffee imported from other sources, the prospects of procuring a share of the trade should be good. It is important that the coffee should be properly graded and *not* oily. East African coffee is being offered at about £112 10s. per ton.

Peanuts.—The demand for peanuts in New Zealand is good. The principal sources of supply are Java, China, Jamaica, Straits Settlements and East Africa, the most popular being the Chinese peanuts, which are large and are supplied to the grocery trade, while a good demand exists for the small Java peanuts which are used in confectionery. Prices are now fairly low and recent quotations are 30s. to 31s. per cwt. c.i.f. and e., the unshelled* nuts being imported to a large extent to save on the freight.

Castor seed.—There is no demand for this, there being no plant in New Zealand for crushing the seed and the oil being regularly imported in preference.

Turmeric.—There is a fair demand for the powder, none for the root. It is principally used for cattle dressing and the price recently quoted is 9d. per lb landed cost from the United Kingdom.

Banana figs.—Firms approached have been unable to give any information regarding this product and the name does not seem to be familiar with the New Zealand merchant houses.

Banana flour.—This is not at present being used to any extent in the Dominion, but it is thought that it might be suitable for confectionery, &c., and firms might be induced to give it a trial.

Dried chillies and spices generally.—The demand is good, the principal sources of supply being the Straits Settlements, East Africa and Jamaica.

ADDITIONAL NOTES BY THE ACTING SUPERINTENDENT OF AGRICULTURE.

Leaf tobacco.—Most of the tobacco grown in Fiji is of inferior quality, and at present meets the local demand. But there are many parts of Fiji where the climate is very suitable for tobacco, and there seems no reason why a superior quality of leaf tobacco should not be grown for export to the United Kingdom. In this connection the following extract from a letter received from a tobacco-leaf merchant at Nottingham will be of interest:—

For tobacco other than cigar-leaf there is a considerable market here (which is greatly helped by the preferential duty on all Empire-grown tobaccos) for two distinct types of tobacco, one a bright, mild free-burning type of leaf, as near lemon colour as possible, and the other grade a thick, dark, heavy-bodied, leathery tobacco. The following are a few remarks on the condition applicable thereto:—

As the duty is so very high all tobaccos must be shipped quite free from sand, &c., Stalks also must be well butted (many shippers take out the midrib which is preferable). All leaf should be graded for colour, texture, and length and no scrap or slightly inferior leaf should be included or even shipped separately, owing again to the high duty; another most important point is moisture, and it may be taken almost as a general rule that tobacco should be almost brittle before being shipped, containing not more than 12 per cent. of moisture.

We have every confidence that the coming year will be a great one for Empire-grown tobaccos, as English manufacturers here are bringing these growths more into use. I would therefore strongly advise you, if you wish to establish your tobacco in the English market, to ship a few bales on consignment to me or to a Bank in this country in the first place and I shall be pleased to sell the same for you and to report thereon.

The name of the above firm together with details as to the methods of shipping tobacco will be given to anyone who is interested is this crop.

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* It appears from the context that this should be shelled.—EDITOR.

Maize.—It will be seen from the above notes that there is a market for maize in New Zealand, provided it is "clean, fine and whole." Most of the maize at present grown in Fiji is of very poor quality, but its quality could be greatly improved by growing it from imported seed of a superior variety, and the yield could be greatly increased by the use of fertilisers. Maize is subject to the attacks of the grain weevil and the maize moth, and unless special precautions are taken the maize is very quickly spoilt. It is by many supposed that the maize in Fiji is so liable to insect attack because it is not sufficiently dried, but this is not correct; analyses of Fiji maize made by me (see *Agricultural Circular*, Vol. 2, No. 2, p. 27) showed that it did not contain an excessive quantity of water, and that the percentage of water in it was very similar to that in maize grown in other parts of the world. Fiji maize is not by any means peculiar in its liability to insect attack. Exactly the same trouble is met with in all tropical countries where maize is grown, and can be prevented either by fumigation with carbon bisulphide, which is extensively practiced in the United States of America, or by kiln drying, which is done in the West Indies. The attacks of the above-named insects can be diminished to a large extent by storing the grain in the ear, and also to a far larger extent by growing varieties of maize with a long tight-fitting husk (*i.e.*, the spathe surrounding the cob), which protects the enclosed grain from insect attack, and cobs with such a husk can be kept for a long time free from insects if the husk is not removed.

Maize is regarded by most people in Fiji as a food for horses and fowls only, and it seems to be forgotten that in the Southern United States, the West Indies and South Africa maize is used to a large extent as human food; and unless maize is used here for this purpose there will constantly be overproduction. Maize is a highly nutritious and valuable food for man, and is largely used in the West Indies in the form of "corn meal," *i.e.*, the whole grain ground in a coffee mill, similar to the machine generally used for grinding yaqona here. Freshly-ground maize does not keep well owing to the contained oil becoming rancid, thus imparting an unpleasant flavour to the meal. The oil is chiefly contained in the germ, and in making maize meal with modern machinery this is removed. In the West Indies a considerable business is done in grinding maize for human food; for this purpose the entire grain is ground including the germ, so that the meal thus produced has to be consumed within the space of a few days. The ground maize can be boiled and eaten like porridge with sugar and milk, or it may be cooked with meat or fish, when it forms a very palatable dish. Before cooking the ground maize should be washed, like rice, by stirring it with water; under these conditions the outer layer of the maize grain which is hard and woody floats on the surface of the water and can be poured off; this process should be repeated several times until after standing a short time the water remains clear.

Coffee.—Coffee, both Arabian and Liberian, has been growing at Nasinu Experimental Station for many years, and has grown very well and borne very good crops of berries. It is well known that coffee was once an important industry in Fiji until most of the bushes were destroyed by the coffee leaf disease, but it is worthy of note that the coffee at Nasinu has been very slightly affected by this disease. Owing to the serious ravages of this disease in the past it would not be advisable for any one in Fiji to put his whole capital into coffee, but if any one were to plant up , say, 5 to 10 acres of coffee as a side line it would probably be a good investment.

If coffee of good quality were produced there here would appear to be no difficulty in finding a market for it. Inquiries made from a firm in Sydney

elicited the information that they were buyers of coffee and it would be necessary for anyone proposing to sell to them to submit samples. At the time of writing (April, 1922) they were importing coffee from Java at about 50s. c.i.f.e., but added that " better qualities are worth more money."

Peanuts.—The above notes show that there is a good market in New Zealand for Chinese peanuts, and there is no reason why these should not be grown in Fiji for export. The peanut is a good crop for the small planter with a limited capital; the crop matures in about four months, is easy to harvest and requires no expensive machinery for planting or harvesting, if grown on a small scale. Peanuts grew very well at Lautoka Experimental Station, and a sample of these sent to the Imperial Institute in 1908 was favourably reported on (see *Bulletin of the Imperial Institute*, Vol. VII, 1909, p. 272). The peanuts at present grown in Fiji for local use are mostly the small ones of the Java variety. If anyone is intending to grow peanuts for export to New Zealand it would be advisable to grow the Chinese variety, and it would be necessary to import the seed for this purpose. After the first crop has matured only the very best peanuts should be retained for planting the next season's crop. With seed crops the best are very often sold and the worst retained as seed; this practice quickly leads to the deterioration of the crop, and should be carefully avoided by anyone who grows peanuts for export to New Zealand.

Peanuts grow best where the rainfall is under 100 inches per annum, and it is therefore recommended that they be grown in the dry parts of Fiji only. They require a light sandy or loamy soil, which is well drained. If the soil is too heavy not only will the crop be small, but great difficulty will be experienced in harvesting the crop, and its appearance and market value will be spoilt by soil adhering to the mature nuts. The best time for planting appears to be February and March, provided that there is sufficient rain; the crop will then mature in June and July, which are the driest months of the year. Before planting it is necessary to plough the land, and reduce it to a fine tilth; the reason for this is obvious when it is borne in mind that the peanuts develop under ground (hence their name of ground nuts), and the neglect of this preliminary cultivation will reduce the yield. Before planting the peanuts should be shelled, and 24 to 30 lb of shelled seed are required to plant an acre. The seed should be planted about two inches deep and eight to twelve inches apart in rows three feet apart. The soil between the rows should be weeded and cultivated until the vines occupy most of the ground. When the peanuts are mature, which is known by a slight yellowing of the foliage, the whole plant should be dug up and allowed to dry. The peanuts can then be picked by hand and great care should be taken to see that no soil or leaves or other extraneous matter is mixed with the peanuts, or it will spoil their appearance and lower their commercial value. The yield per acre is of course largely influenced by locality, climate and the experience of the grower, but in the United States of America 40 to 50 bushels, *i.e.*, 900 to 1,500 lb according to the variety, is considered a fair yield per acre (*Peanut Growing for Profit, Farmers' Bulletin*, No. 1,127, U.S. Dept. of Agriculture).

Banana figs.—These are prepared by drying the pulp of the fully ripe banana. By drying ripe bananas in the sun I found as a result of several experiments which agree very closely amongst themselves that the banana figs are 31·0 per cent. of the weight of the peeled banana and 21·8 per cent. of the weight of the whole banana. From the above data the yield of figs per bunch can be calculated. A bunch of bananas weighs from 20

to 100 lb, with an average of 50 lb. Neglecting the weight of the stalk, which is very small compared with the weight of the bunch, the yield of figs per bunch would vary from 4·36 lb to 21·8 lb with an average of 10·9 lb (see *Agricultural Circular*, Vol. 2, No. 5, p. 107). Last March, through the kindness of Mr. A. H. Witherow, I was able to prepare some banana figs in his dryer at Nasoqo. Some of the bananas were cut in halves before being dried, and others were dried whole. The half bananas dried much more quickly than the whole bananas and were very attractive in appearance, but they were far more quickly attacked by insects on storing than the whole dried bananas. Hence it is recommended that bananas be dried whole, even though they take far longer to dry than the halves and are not so attractive in appearance.

About 4 lb of the whole-dried bananas prepared in Mr. Witherow's dryer were given to a representative of Messrs. Turners and Growers Ltd. of Auckland who was in Suva. Later a letter was received from this firm, an extract from which is given below:—

> We have to thank you for the sample of dried bananas which are of very fine quality. There is undoubtedly a market to be had in New Zealand for these, but a certain amount of advertising, &c., would need to be done to draw the attention of the general public. We would suggest that a trial shipment is sent to us of, say, 10 cwt., which could be distributed among the leading grocers and fruiterers with the idea of immediately getting the purchasing public buying.

It thus appears that there is a very promising market for banana figs in New Zealand, and this market could be supplied by drying the bananas not fit for shipment; many of these are rejected simply because they are too ripe; but others are rejected because they are undersized or immature, and even these can be used to make banana figs. Last year I prepared banana figs from a case of bananas which had been rejected. The bananas were of very poor quality, and there was no wonder that they were rejected; but the figs prepared from them were very similar in appearance and flavour to figs prepared from some very fine Gros Michel bananas. This shows what use could be made of all the bananas too small for export, which so far have been absolutely wasted (*Agricultural Circular*, Vol. 2, No. p. 107). Formerly, with ship-side inspection only, all the rejects remai in Suva; as many as possible were sold for what they would fetch, an rest were thrown into the harbour and were absolutely wasted. B with packing stations on the Rewa river and its tributaries most of the rejects remain at the packing stations, and could no doubt be bought very cheaply; and if anyone started a dryer at a convenient centre somewhere up the Rewa river and arranged to buy all the rejects from the packing stations with the object of preparing banana figs it would in my opinion pay him well.

Banana flour.—This was prepared at the Chemical Laboratory during last year by drying the pulp of the green banana and then grinding the resulting "banana chips" in a coffee grinder. The preparation is fully described in the *Agricultural Circular*, Vol. 2, No. 3, pp. 48–49, and the yield and chemical composition are given in the *Agricultural Circular*, Vol. 2, No. 5, pp. 104–105. Whether it would pay to make banana flour in Fiji depends of course on the price it would fetch in the open market, but it is probable that it would pay best to export the fresh fruit and dry the rejects. If, however, this export ceased owing to strikes or any other cause then it might be possible to make use of the bananas by turning them into flour.

INSECTS AFFECTING COTTON IN FIJI.

By H. W. Simmonds, F.E.S., Acting Government Entomologist.

Introduction.

In view of the attempt now being made to re-establish the cotton industry in Fiji, some account of the principal insects at present known to attack this crop should prove of interest. No cotton has been grown in this country on a commercial scale for many years, except a small patch in the Experimental Station at Lautoka up to 1917, and it is probable that when such is the case a number of minor pests, not at present noticed, will be found to be present. Amongst these it is probable that cutworms will be found to do damage to the young seedlings.

Lepidoptera attacking Cotton.

Earias fabia.—The larva of this pretty little moth is a common pest of Hibiscus buds in the drier portions of the group, where it also attacks okra and vau besides cotton. In cotton it not only attacks the buds, but Knowles states that it often attacks the tops of the branches, burrowing down the stem, and causing it to wilt and drop over. I have as yet only found it in the bolls, where its presence is easily detected (as in the buds) by the hole which it makes in entering, and the frass and gummy matter which exudes from it. The moth itself is about $\frac{5}{8}$ inch across the expanded wings, the fore-wings yellowish with variable linear green markings, and a blackish margin. The hind wings are pearly white with a blackish edge and white fringe. The larva is dark green, almost black, with a few whitish markings and covered with spines. When full fed it leaves the bud or boll, and forms a tough brown cocoon like an inverted boat, its keel sharply pointed at one end.

Control.—Hand picking of affected shoots was found necessary at Lautoka, whilst growers should destroy all Hibiscus, vau or okra in the neighbourhood of their plantations. The establishment of a close season for two months would go far towards keeping this pest under control.

Gelechia gossypiella, Saund.—The presence of this disease, one of the most serious affecting cotton, was not suspected until June of this year, when the writer was handed three diseased bolls of Sea-Island cotton from Nadi by Mr. M. Kennedy. One of these was found to contain the characteristic pink larva of this moth. The whole country between Penang and Nadi was therefore carefully searched, and the disease was found to be present at a number of points along the coast, particularly at Penang, Rabulu, Teidamu and Ba* It is difficult to say when the moth reached Fiji, but there is some evidence that it has been here several years. It had not been noted at Lautoka up to 1917, but on the other hand its presence in wild cotton at Rabulu and sporadic outbreaks along the coast seem to require a considerable time to account for its distribution, there being very few cotton or other of its food plants present to enable it to spread. There is also in the collection of the Department of Agriculture a very worn and damaged insect labelled "Suva, November, 1906, bred from larva found in cotton seed," which I have very little doubt is this moth, and was not apparently recognised at that time. It is not stated whether this seed was local or imported, and if imported whether it was destroyed. In 1907 Knowles bred a number of *Earias fabia* from cotton at Lautoka and this moth was not

* Pink boll-worm has been found in Bua and Macuata since the above was written.—Editor.

present amongst these. As bearing upon this matter a hymenopterous parasite was bred from the Rabulu bolls, and if this should, as appears probable, prove to have come from this moth it may when identified throw some light on the origin of the pest in Fiji.

Description of moth.—The moth is about ¾ inch across the expended wings. It is rather obscurely marked, being brownish in colour with a coppery lustre when freshly emerged. At the apex of the wings is a blackish blotch, separated from a second blotch which crosses the wings by a narrow lighter band. A few other black spots and marks are scattered irregularly about the wing. The hind wings are silvery grey, with a very wide fringe which extends along the apex of the front wings also. The larva is whitish, with a number of pink bands and spots upon each segment which give it a general pinkish hue, from which it derives its common name of pink bollworm. The head is black and very conspicuous. The larva feeds in the interior of the bolls, eating out the centres of the seeds, and generally forming its cocoon and pupating within the hol owed out seeds; occasionally however it uses the lint for this purpose. Unlike *Earias fabia* the hole made by the entrance of this larva is not visible from the outside of the boll. The amount of damage done varies from the destruction of one or two seeds to the complete destruction of the whole interior of the boll.

Control.—It has been found in all parts of the world where this moth has established itself that the only effective control is by means of a close season of not less than two months during which no cotton is allowed to be grown, whilst at the end of each growing season all old plants and particularly the bolls must be destroyed by fire. This close season is also most helpful in dealing with *Earias*, and the cotton stainers mentioned below. Of course growers should carefully burn all bolls found to be diseased during the growing season.

Note.—Some confusion seems to exist in the minds of certain people in Fiji that this pest is the same as the boll weevil of America. This is not the case. The boll weevil (*Anthonomus grandis*, Boh.) is a beetle, while the pink bollworm is the larva of a small moth.

Cutworms.

These are the larvæ of various noctuid moths which feed at night, hide underground during the day. Although not at present reported as troublesome they are likely to prove so at times. Deep ploughing of all weeds, and clean cultivation are the best remedies, when birds, fowls, &c., do much to destroy these vermin. Should they however become very numerous it may be necessary to resort to poisoned bait. A formula recommended by the Canadian Department of Agriculture is 50 lb of bran slightly moistened by sweetened water, and dusted with 2 lb of Paris green, so that each piece of bran gets some of the poison. This is scattered by hand in the field after dark, and is said to be most effective.

Hemiptera (Plant-sucking Bugs) attacking Cotton.

Cotton stainers, Dysdercus insularis and *D. impictiventris*.—These are serious pests of cotton not only from the damage they do to the plants themselves by piercing the bolls and sucking the juices, but they stain the lint when the bolls open in ripening, and also numbers get crushed in the gins and so damage still more lint. Another serious charge against them is that in piercing the young bolls they introduce the spores of fungi which set up rots, and these rots destroy many bolls.

The larvæ of these insects are wingless bugs, which often cluster in considerable numbers round young cotton bolls. They are yellowish red in colour, and when crushed exude a yellow fluid with an offensive odour.

When full grown they develop wings, and the species can be distinguished by their markings. *D. insularis* is the species commonly met with on cotton, and has a red head, thorax and the front half of the front wings, with a black spot in the centre of each wing. The back portion of the wings is black, Size about ½ inch long *D. impictiventris* I have not yet met with attacking cotton, but it is likely to do so. It differs from *D. insularis* in that the front half of the forewings is grey instead of red. Size about ⅝ inch long. There are several other species in Fiji which may be found to attack cotton when that crop is grown on a large scale.

Control.—Clean cultivation is important. These insects also feed on the common weeds of the genus *Sida* and these should be destroyed. *Thespesia populnea* (Fijian mulomulo), a tree commonly found along the beaches, is also a common food plant not only of cotton stainers but also of *Gelechia gossypiella* and the bug, *Tectocoris lineola*, which also attacks cotton, so that steps should be taken to destroy all these trees wherever cotton is grown.

The insects themselves may be destroyed by means of traps. The most effective of these probably being by means of heaps of cotton seed placed in a shady place, and kept slightly damp These if visited in the early morning will be found to have attracted a large number of the larvæ of the stainers, which can then be killed by means of boiling water, or it was found in St. Vincent that a gasoline torch projecting a blue flame was most effective (*Agricultural News*, Aug. 25th, 1917, p. 267).

Shield Bugs.

Tectocoris lineola.—The bright blue nymphs or larvæ of this bug are sometimes present in very large numbers on cotton, and they also attack several other plants the chief being mulomulo, *Thespesia populnea*, as noted above. The perfect insect is exceedingly variable, the males being blue and green, whilst the females vary from plain dull yellow to yellow blotched with green, blue, and brown. Size of adults about ⅝ to ¾ inch long and ½ inch wide.

Aphides, Mealy Bugs and Scales.

A mealy bug, probably *Pseudococcus virgatus*, is not uncommon, generally [illegible] the bases of the bolls. These are generally kept in check by natural enemies such as lady-birds, but a spray of kerosene emulsion would be found effective if they became very numerous.

Aphis gossypii.—This dark coloured aphis sometimes attacks the young shoots in numbers. It is however soon discovered and destroyed by *Syrphus* flies and lady-birds.

Lecanium sp ?—A brown scale has also been noticed at times, but so far not numerous enough to do serious damage. I found it present at Ba. Specimens have been sent to England for identification.

Several other insects, principally moths, and a beetle have been bred from diseased cotton bolls by the writer; these have been sent to England for identification, but it is thought that all are rubbish feeders, only attacking the bolls after they had been damaged by other causes.

Fungoid Disease.

A disease causing a rot of the lint and seeds is apparently widely distributed. Similar diseases have been found to be present in other parts of the world where cotton is grown, and these have been shown to be spread by the punctures of cotton stainers and bugs, so that the most effective method of dealing with these troubles is to destroy the causal agencies by every means possible, *i.e.*, clean cultivation, hand picking and trapping, and the destruction of the food plants on which they pass over the season when no cotton is grown, *i.e.*, *Thespesia populnea* and the two species of *Sida*.

BUD-ROT DISEASE OF COCONUTS IN FIJI.

By H. W. Simmonds, F.E.S., Acting Government Entomologist.

This disease seems to have been present in Fiji for at least ten years, but did not cause much anxiety until the past eighteen months, when a large number of trees have had to be destroyed on account of it.

Distribution and Conditions favourable to Bud-rot.

The disease is almost entirely confined to the wetter portions of the group, where it is commonly found on the back parts of estates along the foothills, being rare on the coast and increasingly abundant as one moves inland. Whether this is a matter of humidity only, or whether the fact that the majority of the trees along the coastal area are old trees is uncertain. The disease certainly attacks trees between 5 and 15 years of age far more frequently than older trees, but at one village in the hills of Vanualevu the writer saw a number of trees dead or dying from what was undoubtedly this trouble, which would range from 20–35 years in age. This was in an area of excessive rainfall.

Symptoms.

In Fiji the first symptom generally noticed is the wilting and falling over of the central unopened leaf of the tree, leaving an outer ring of leaves and nuts which the tree gradually sheds, until only a bare pole is left.

If an affected tree is cut down, and the outer leaves removed separately, one presently comes to an irregular greenish brown or yellow spot, which communicates with the central portion of the tree, the whole of which will be found to be rotten and in a very foul smelling condition.

Examination of Diseased Trees.

A large number of trees were examined by the writer in order to try to trace the probable source and course of the primary infection. This was apparently found in a number of cases in the greenish spot described above which generally occurred at the base of about the eighth leaf from the central core, or the corresponding flower spathe. This spathe would in such a case turn black and abort, although younger spathes on the opposite side of the tree would continue to develop their nuts for some time longer.

The infection frequently seemed to take a lateral course before finding its way to the central core, which it did not by direct penetration, but downwards and under at the point of junction of the next older leaf.

Second Infection of Tree already dying of Bud-rot.

One tree which was examined and cut down was dying in the usual manner, the heart leaf wilting and dropping over. I then removed the outer leaves one by one until I came to the twelfth or thirteenth leaf from the central core. Here was a small spot about 1½ in. by 1 in. by 1 in. which penetrated the actual stem and had every symptom characteristic of bud-rot, including the smell, and which was surrounded on all sides (except a slight trace where it made contact with the leaf base, and so the air) by healthy tissue. About a foot above this I came upon the main rot from which the tree was dying, the intervening tissue being quite healthy. It seemed to me that this was a case of secondary infection of the same tree, and was of importance as showing the way in which infection took place, *i.e.*, at the bases of the leaves; the rot in this case as in others observed had travelled downwards, and under the overlying leaf-base, and not through it; no lateral course was however visible in this case. Also I thought that it might be possible in such an early infection to show by the presence of mycelium whether

fungi were the probable primary cause of the disease, the bacilli following. With this object in view I cut the whole block out with its surrounding healthy tissue, and after soaking in formaldehyde forwarded it to the Imperial Bureau of Mycology for examination. I have extracted the following from their report:—

On a microscopical examination the only visible organism is an intercellular fungus with the characters of a *Phycomycete*. Bacteria are probably also present. The fungus seems to agree in its mycelial characters with the parasitic *Phytopthoras* that have been described in other countries as a cause of coconut bud-rot, but it is impossible to be certain what the fungus is, in the absence of any fructifications.

The presence of a mycelium of this type seems to make it probable that our bud-rot is of the same nature as those reported by Ashby in Jamaica, by Butler in India and Reinking in the Philippines as being primarily caused by some species of *Phytophthora*, and as such the same precautions taken against fungi of this group in other crops will apply to coconuts also.

The disease is likely to be most prevalent in humid areas and areas of continuous rainfall, whilst its spread would be greatly assisted by gales or hurricanes, which by straining the trees leave openings for the spores to enter, and such is found to be the case in Fiji. Growers should therefore give serious consideration to this matter, before planting up back country subject to such humid conditions.

All diseased trees should be cut out, and the head burned at once, whilst it would probably be of considerable value as a prophylactic measure to spray badly-affected blocks when the trees are young with a strong Bordeaux mixture, remembering that the infection takes place at the bases of the leaves, and it is into such parts that the spray is required to run. This is only suggested as a preventive in a badly-infected block. Once the tree is attacked cutting out and burning to prevent further spread is the only method.

NOTES ON GRASSES IN FIJI.

By C. H. Wright, M.A., F.I.C., Government Chemist.

As a result of many inquiries recently received I have compiled the following notes on grasses; and it is hoped that they will be of interest and supply the required information.

Below I give a list of the names of the best-known grasses, which have either English or Fijian names, with their synonyms in brackets. The order of the genera is the same as that in *The Queensland Flora* by F. M. Bailey, who followed that of Hooker in *The Flora of British India*.

**Paspalum scrobiculatum, L.*	Fijian Co dina.
Eriochloa subglabra	Carib grass.
Panicum distachyum, L.	Thurston grass.
Panicum barbinode Trin.	Para grass, Fijian Karasi.
Panicum maximum, Jacq.	Guinea grass.
**Oplismenus burmanni*, Palis.	Fijian Co damu.
Setaria glauca, Beauv. (*Panicum glaucum, L.*) (*Pennisetum glaucum*, R. Br.)	Fox-tail grass.
Pennisetum longistylum (*Pennisetum clandestinum*)	Kikuyu grass.
Pennisetum setosum	Mission grass.
Pennisetum purpureum, Schumacher . ..	Elephant grass or Napier's fodder.

Cenchrus echinatus, L...	Burr grass, Fijian Se bulubulu.
Stenotaphrum americanum, Schrank (*Stenotaphrum secundatum*, Kuntze)	Buffalo grass.
**Chrysopogon aciculatus*, Trin. (*Andropogon aciculatus*, Retz.)	Seed grass.
Sorghum halepense, Pers. (*Holcus halepense, L.*)	Johnson grass.
Anthistiria ciliata, L.	Kangaroo grass.
Cynodon dactylon, Pers. (*Capriola dactylon*, Kuntze).	Couch grass, Bermuda grass, or Bahama grass, Fijian Kabuta.
Chloris gayana, Kunth	Rhodes grass.
**Eleusine indica*, Gaertn.	Crow's foot, Fijian Co vatu or Vorovoro i sivi.

The scientific name of Para grass is sometimes stated to be *Panicum muticum*, Forsk, or *Panicum molle*, Gris; but according to C. V. Piper, Agrostologist to the Bureau of Plant Industry, U.S. Department of Agriculture, quoted in *Para and Paspalum; two introduced grasses of Guam*, Bulletin No. 1, Guam Agricultural Experiment Station, by G. Briggs (p 7) " The proper name of Para grass is *Panicum barbinode*. *Panicum muticum*, which was applied to a grass in Ceylon, is, with scarcely a doubt, the same species. *Panicum molle* is an entirely distinct species of grass, but which some botanists at one time supposed was the same as Para grass." On the other hand, A. S. Hitchcock, Systematic Agrostologist, U.S. Department of Agriculture, in a recent publication, *The Grasses of Hawaii*, Memoirs of the Bernice Pauahi Bishop Museum, Vol. VIII, No. 3, 1922, gives the synonyms, wherever possible, but in the case of Para grass gives the scientific name as *Panicum barbinode* only.

In the above list of grasses those marked with an asterisk are recorded by Dr. B. Seemann in *Flora Vitiensis*. This work was published in between 1865 and 1873, but Dr. Seemann was in Fiji during the year 1860–61. These same grasses are also recorded by John Horne in *[illegible] in Fiji*, London, 1881. It therefore appears at first sight that all the other grasses are recent introductions, at any rate since John Horne was here in 1879. In this connection it is of interest to note that neither of these botanists recorded *Rhizophora mangle*, the mangrove known by the name of tiri, and it can hardly be supposed that this plant has been introduced into Fiji since 1879; it is much more probable that this mangrove was overlooked, because as Dr. H. B. Guppy remarks in *Observations of a Naturalist in the Pacific*, Vol. II, p. 441, " both these botanists were naturally more interested in the inland regions than in the coastal swamps." Hence the fact that a particular plant is not recorded by these botanists cannot be taken as a definite proof of its introduction since their time, if there are good reasons for supposing the contrary. In the case of one of the above grasses, viz., *Cynodon dactylon* (Couch grass), it seems to be certain that this grass was inadvertently overlooked by Dr. Seemann and John Horne, and is not a recent introduction. This is a widely distributed grass occurring in Europe and in the tropics in the old and new worlds, and several old residents in Fiji have assured me that it was here in John Horne's time. Further, this grass has a definite Fijian name by which it is well known all over Fiji, viz., kabuta. This is in my opinion conclusive proof that it is an indigenous grass, because most indigenous plants have perfectly definite Fijian

names, whereas introduced plants are very often not named or if named at all are not known by the same name over any considerable area; and those names are often merely corruptions of the English names, *e.g.*, karasi, the name by which Para grass is generally known.

The other grasses are all introduced, many of them during the last few years. It appears that Guinea grass was introduced in the early seventies; Thurston grass was introduced by Sir J. B. Thurston, from Ceylon, as a fodder grass; and Johnson grass was introduced for the same purpose by the Colonial Sugar Refining Company. From information kindly supplied to me by Mr. J. B. Turner it appears that a small parcel of Para grass seed was brought from Sydney about 1877 by Messrs. Scott and Harvey, who then kept a store at the junction of the Wainimala and Wainibuka rivers. This seed was placed in a drawer in the store counter and became accidentally wetted during a flood, when the water rose above the counter. Afterwards the wetted contents of the drawer were thrown into the river, and the seeds took root on the river banks, which I am told were formerly covered with reeds (*Eulalia japonica*).

Analyses of Grasses.

In making an analysis of a grass the water is first determined in a portion of the sample as soon as possible after the sample is taken, because grasses when they are cut very quickly lose water. The rest of the sample is then cut up into small pieces and dried at air temperature. This air-dried material is then finely ground up, and in it are determined water, nitrogen, oil, fibre and ash. The percentage of nitrogen multiplied by 6·25 gives the percentage of protein, *i.e.*, the nitrogenous constituents, formerly known as albuminoids, on the assumption that they contain 16 per cent. of nitrogen. The percentage of carbohydrate is found by difference by subtracting the sum of the percentages of water, protein, oil, fibre and ash from 100. These methods seem at first sight very crude methods: and no doubt they are, since they take no account of the constituents peculiar to particular grasses; but they have the great advantage that they are very generally adopted, and that analyses of grasses and other food-stuffs made by these conventional methods in different parts of the world are strictly comparable.

From the analysis of the air-dried grass the composition of the dry matter can be calculated; and if the percentage of water in the original sample has been determined the composition of the fresh grass can then be calculated. There are thus three ways in which the composition of grasses can be stated, viz., the analyses of the air-dried material, the dry matter and the fresh grass. Analyses of the air-dried material are not strictly comparable, because the percentages of water in these vary, being dependent on the climatic conditions (temperature, hygrometric state, &c.) under which the grasses were dried. The percentages of water vary to a far greater extent in the fresh grasses, depending to a large extent on the state of maturity, and the best way to compare one grass with another is by comparing the analyses of the dry matter. In Tables I and II are given the analyses of the fresh grasses and the dry matter of the same grasses taken from several sources, the references to which are given at the end of Table II.

Grasses, like all vegetable products, vary in composition with the climatic conditions under which they are grown and the state of maturity, &c. A chemical analysis gives the total percentage of each constituent, but the whole of each constituent is not utilised by the animal to which it is fed, since only a certain proportion of each constituent is digested. The actual percentage of each constituent digested, the digestion coefficient, can be

determined by experiments on living animals only. Then, too, a chemical analysis does not include the palatability, because it cannot be measured; but it is obvious that this is a most important factor, since animals will refuse a food which is unpalatable no matter what is chemical composition is. Hence it will be seen that a chemical analysis of a grass is only a partial guide as to its feeding value, and in considering the suitability of a particular grass as a fodder many other factors have to be taken into consideration, such as palatability, habit, yield, propogation, &c.

TABLE I.

	Water.	Protein.	Oil.	Carbohydrate.	Fibre.	Ash.	Reference.
Paspalum dilatatum ..	73·6	3·0	0·6	11·1	9·2	2·5	*a*
Carib grass	81·8	2·3	0·7	7·3	6·0	1·9	*c*
Para grass	74·6	2·3	0·3	10·9	9·1	2·8	*a*
do.	72·8	1·7	0·5	13·4	9·2	2·4	*d*
Guinea grass	64·5	1·9	0·3	19·4	10·0	3·9	*a*
do.	71·5	2·2	0·7	12·1	10·9	2·6	*d*
Mission grass	89·0	1·1	0·4	4·7	3·4	1·4	*c*
Buffalo grass	63·1	1·4	0·4	22·7	9·9	2·5	*a*
do.	80·8	1·4	0·3	9·3	6·4	1·5	*e*
Seed grass	41·0	3·1	0·4	36·0	16·3	3·2	*a*
Johnson grass	70·9	2·5	0·9	14·4	9·3	2·0	*d*
Couch grass	45·5	3·7	0·3	32·6	12·5	5·4	*a*
Crow's foot	77·8	1·9	1·0	9·2	7·4	2·7	*a*

TABLE II.

	Protein.	Oil.	Carbohydrate.	Fibre.	Ash.	Reference.
Paspalum dilatatum ..	11·2	2·4	42·2	34·5	9·6	*a*
do.	8·1	2·7	47·6	31·8	9·8	*b*
Carib grass	12·4	3·7	40·3	33·3	10·3	*c*
Para grass	9·1	1·1	42·9	35·9	11·0	*a*
Guinea grass	5·5	0·9	54·6	28·2	10·9	*a*
Mission grass	9·9	3·5	42·9	31·3	12·4	*c*
Buffalo grass	4·1	1·1	62·3	28·2	4·3	*a*
do.	8·6	1·6	48·6	33·1	8·0	*e*
Seed grass	5·0	0·6	61·2	27·6	5·6	*a*
Couch grass	6·9	0·6	59·8	22·9	8·8	*a*
Crow's foot	8·4	4·6	41·2	35·5	10·3	*a*

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b. G. Briggs, *Bulletin No.* 1, Guam Agricultural Experiment Station, 1921, pp. 22 and 39
c. C. H. Wright, *Agricultural Circular*, Vol. 1, pp. 183–4.
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NOTES ON THE COCONUT LEAF MOTH

By H. W. Simmonds, F.E.S., Acting Government Entomologist.

When travelling from Suva round to the dry side of Vitilevu it is most noticeable that whilst one travels along the wet portion of the country as far as Penang all the coconuts observed are brown and diseased from the attacks of this moth, but as soon as Penang is passed a change occurs, and for considerable distances no sign of the disease is visible, and the trees yield as heavily as anywhere else in Fiji. This improved condition lasts until one reaches the wet districts again when *L. iridescens* is as bad as ever.

It is not that the moth does not thrive in the drier areas, because from time to time it breaks out at various places along the coast, when the havoc it causes is as bad as on the wet side; and in fact the worst patch I have seen was on the Vitogo river at Lautoka. Search was therefore made to see whether any agency was at work controlling this pest on that side of the island not present in the Suva district. None was however found. Many hundreds of eggs were collected, but they yielded 100 per cent. of larvæ, whilst no sign of parasitism was present in the large number of pupæ examined. The moth does however die out there as in the wet districts from some disease (fungoid or bacterial) when it has become very numerous, and the comparative immunity of the dry districts to *L. iridescens* lies I think probably, in the fact that the clumps of coconuts are more isolated, and separated by wide areas of cane, without any other palms upon which the moth can feed, and so when it dies out on a given patch it is a long time before re-infection takes place, and the trees have time to recover and yield heavily in the meantime.

L[illegible]
and [illegible]

A new Food Plant for L. iridescens.

When examining the outbreak referred to above on the Vitogo river in company with Mr. Phillips of Lautoka he called my attention to a specimen of *L. iridescens* on a banana growing beneath the coconut trees. I thought this had doubtless dropped from one of the affected palms above, but shortly afterwards we found more, and these, whilst they may have dropped from the palms overhead, were certainly feeding upon the bananas in their characteristic way. Later, we discovered several batches of eggs of the same insect laid upon the banana, so that it is probable that some at least had started life upon this plant.

REPORTS ON SCALE IN GAU.

By M. A. Forsyth, Inspector of Plantations.

First Report.

An opportunity to proceed to Taveuni not offering for a few days, I seized the chance of visiting Gau as residents there were expressing alarm in regard to the spread of scale. I reached Sawaieke at 5 p.m. on the 16th May, and early next morning proceeded on foot along the coast to Vadravadra, calling at the following villages:—Nawaikama, Nukuloa, Levuka and Lovu. On previous visits I dealt with slight attacks of scale on yaqona and coconut trees at each of these places by cutting and burning the trees and spraying surrounding plants with lime-sulphur solution. Where this was done there is no reappearance of scale. I was, however, very disappointed to find that the disease had appeared to a limited extent in fresh areas. I observed that in all cases the trees attacked were in the native gardens where bananas and yaqona had been grown. The coconut trees are not badly attacked and the natives are willing to destroy these; and, as a matter of fact, are already doing so, but fail to realise the necessity of burning. They need supervising, and with supervision I feel confident a serious outbreak will be averted. At Lovu I noticed a plant of yaqoyaqona (*Piper macgillivrayi*) was badly infected and I advised its destruction by cutting and burning.

Retracing my steps to Sawaieke I observed this plant closely and found that though it is nowhere profuse in its growth the scale appears to have selected it in preference to other plants. Many yards separate the plants in many instances, but the scale has passed intervening plants to have selected this particular one. I have concluded from my observations that the previously suggested theory that scale is wind-borne is not altogether correct. Invariably the lower leaves are attacked first, which is also the case with yaqona, varas, &c. I should say from this that in its mobile stage it travels along the ground, selects suitable food and settles thereon. As the supply of its choice food dwindles it attacks others (varas, &c.), which as they grow pass it to other trees with which their leaves intertwine. I find that yaqona and banana plants were introduced to these districts from Tailevu some years ago, and conclude that the disease was introduced then, and is only now beginning to attack other than the bush plants they first selected as suitable food.

I think its eradication is possible if taken in hand immediately. To accomplish this the natives need supervision. With the co-operation of the Provincial Commissioner I propose to personally supervise the destruction of this bush plant which is at present a menace to the whole of the coconut areas on the island. I also propose introducing the parasite to bush trees affected to reduce the danger from that source.

Second Report.

Following my special report to you regarding the appearance of scale on bush yaqona (yaqoyaqona) in Gau I proceeded to that island on the 25th June to set the natives to work in an attempt to eradicate and prevent it spreading to coconuts. Mr. Pennefather, Provincial Commissioner, provided me with letters to the Bulis of the three districts instructing them to give me every assistance and to carry out any instructions I might give in regard to the disease. I found the natives willing to do all I wished.

I visited first the Sawaieke district. This district was more severely attacked than any. At the following towns, viz., Lovu, Nawaikama, Levuka, Nukuloa, Somosomo and Sawaieke, a few coconut trees in the native plantations were attacked. These I ordered to be destroyed by fire. I obtained the admission from several natives that bananas, yaqona and taro had been brought from Tailevu for planting purposes, and I feel quite satisfied that this accounts for the introduction of the disease. Several vessels running to these villages have been dealt with under the regulations for failing to report at Levuka for inspection, but it is still possible that evasions occur. Yaqoyaqona only appears to flourish in shady and damp areas close to the seashore. I found it attacked all along the coast, and it appears to find special favour as food for the scale. I found plants here and there dotted all round the island attacked, and always from the lower leaves upwards. As other plants, including varas, &c., intervened between the affected plants, I formed the opinion that the scale preferred the yaqoyaqona, and that the theory that it was wind-borne was not altogether correct. It looks very much as if the scale in its mobile stage works its way along the ground, selecting the plant it prefers as food to settle upon. Invariably the attack is on the lower leaves which would hardly be the case if it were wind-borne. I started all the natives that could be mustered uprooting the plant and growing it into the sea. I found this more satisfactory than their careless attempts to burn it. After seeing the work started in Sawaieke district, visited Navukailagi and started operations there; also the Vanuaso district. The attack in these two districts is slight, but I considered it possible to destroy all yaqoyaqona. At one village in the Navukailagi district I found a few coconuts attacked. These were destroyed. I was unable to see the work completed on this occasion, but left instructions with the Bulis to see that it was so before my next visit, which I propose to make immediately on my return from Taveuni.

ACTUAL AND AVERAGE RAINFALL FOR THE MONTHS JANUARY TO JUNE, 1922.

Province.	Station.	Observer.	No. of years.	January.		February.		March.		April.		May.		June.	
				Act'l.	Aver.	Act'l.	Aver.	Act'l.	Aver.	Act'l.	Aver.	Act'l.	Aver.	Act'l.	Aver.
				"	"	"	"	"	"	"	"	"	"	"	"
Ba	Narovurovu	District Commissioner	..	14·90	..	13.25	..	21·75	..	12·50	..	9·00	..	2·00	..
Ba	Rarawai	C.S.R. Coy. Ltd.	28	13·26	12·52	16·76	16·89	20·71	12·26	16·27	7·51	4·91	3·55	1·97	2·33
Bua	Baulailai	F. W. Whittstock	17	11·10	12·72	5·50	11·91	17·90	14·34	16·90	9·31	7·50	4·62	0·50	2·18
Bua	Nabouwalu	Roko Tui Bua	5	13·50	12·47	12·64	12·04	11·13	12·42	21·51	15·37	6·87	6·45	2·32	3·99
Bua	Wainunu	S. E. Martin	43	19·15	19·10	14·50	17·36	17·40	18·23	25·45	15·90	11·65	11·28	2·10	6·31
Cakaudrove	Savusavu	Wireless Officer	16	9·66	13·32	5·25	9·80	9·45	12·80	21·10	10·62	7·65	7·71	2·45	5·09
Cakaudrove	Vuna, Taveuni	Tarte Bros.	3	13·96	11·52	9·97	15·73	9·12	10·58	24·94	20·82	7·74	7·93	2·28	3·23
Cakaudrove	Waievo, Taveuni	Wireless Officer	16	15·66	12·36	9·61	13·03	6·85	12·49	18·60	9·91	7·42	8·46	1·75	4·58
Colo East	Vunidawa	District Commissioner	10	30·00	15·29	20·00	14·75	12·90	17·53	19·60	14·81	13·80	8·21	1·40	7·11
Colo North	Nadarivatu	District Commissioner	22	11·08	23·72	19·01	22·51	22·78	22·93	30·73	10·58	3·93	5·90	1·72	3·01
Colo North	Tavua	C.S.R. Coy. Ltd.	16	8·01	10·35	9·96	13·48	17·55	11·60	26·62	7·40	5·91	3·54	1·21	1·97
Lau	Munia	H. H. Steinmetz	27	7·61	7·81	3·50	7·60	8·50	8·71	21·04	8·84	6·21	5·11	2·07	4·36
Lau	Nabavatu	Hennings & Allardyce	3	10·81	7·85	7·83	6·35	8·27	8·89	21·87	18·98	8·02	4·24	1·15	1·42
Lautoka	Lautoka	C.S.R. Coy. Ltd.	22	10·17	9·48	11·71	12·81	25·01	11·76	11·72	5·38	7·47	4·20	1·48	2·04
Lomaiviti	Levuka	Harbour Master	28	5.60	9·59	14·50	10·15	11·15	12·26	10·37	10·50	11·12	6·91	0·69	4·35
Lomaiviti	Makogai	Resident Medical Supt.	11	12·42	7·52	9·17	7·29	11·09	10·85	14·62	10·78	7·46	6·17	0·46	3·60
Macuata	Labasa	C.S.R. Coy. Ltd.	28	11·63	13·12	10·57	14·09	16·30	13·34	11·94	8·78	4·55	4·00	1·19	2·20
Nadi	Navo, No. 2	C.S.R. Coy. Ltd.	21	11·46	9·68	12·91	11·95	21·66	9·77	6·27	4·88	3·64	3·15	1·10	1·88
Nadroga	Lawaqa	District Commissioner	16	12·85	9·03	13·67	9·01	10·39	9·33	6·84	6·14	4·79	5·32	1·38	3·42
Ra	Rakiraki	Penang Sugar Coy.	38	11·50	11·75	8·60	14·65	13·28	12·27	19·82	9·96	6·33	4·97	2·29	2·59
Rewa	Suva	Supt. of Agriculture	38	25·15	11·18	16·12	10·30	29·52	15·08	12·41	12·32	8·42	9·94	1·82	5·97
Serua	Navua, Naitonitoni	District Commissioner	6	16·44	12·12	14·74	10·85	21·24	13·05	10·08	16·93	6·34	11·45	2·92	8·09
Serua	Navua, Tamunua	Vancouver-Fiji Sugar Coy.	38	16·03	14·59	15·89	12·18	20·38	15·94	13·11	15·49	6·61	13·14	2·28	8·18
Tailevu	Nausori	C.S.R. Coy. Ltd.	28	24·39	11·81	13·78	12·10	25·72	14·61	12·30	11·92	7·56	9·52	1·70	5·92
Tailevu	Yaralla	Lord & Nichol	..	22·60	..	20·01	..	20·92	..	18·66	..	11·92	..	2·70	..
Rotuma	Rotuma	Resident Commissioner	18	11·86	14·05	8·52	15·71	21·55	13·24	15·20	11·84	17·16	12·48	10·33	8·09

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